

MOTION SICKNESS

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16. Abstract The theory and prophylaxis of motion sickness are briefly reviewed by N. Razsolov (Candidate of Medical Sciences) and K. Andronik. The V.I. Voyachkov and K.L. Khilov "otolith" theory of the causes of motion sickness is discussed, and G.L. Komendantov's definition of four stages of motion sickness is outlined. Further studies of the pathogenesis of the disease by Professor M.D. Yemel'yanov are mentioned. It is noted that double-axis rotation with intermittent and continuous Coriolis accelerations is used to test candidates for piloting and other occupations. Drug therapy now in use for motion sickness is described: the drug now in use is "plavefin" (the one previously used, "Aeron", was ineffective and caused severe side effects). Also mentioned are suppositories with 0.3-0.7 g of sodium bicarbonate which are used daily for 21 days. However, 50 ml of a 4-5% solution of sodium hydrocarbonate administered intravenously appears to be the most effective pharmaceutical means of inhibiting the development of motion sickness.			
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## MOTION SICKNESS

N. Razsolov and K. Andronik

The onrush of scientific and technical progress brings to mankind obvious benefits but simultaneously complex and, in time, insoluble problems. Man becomes all the less mobile; hypokinesis is accompanied by a lowering of statokinetic stability. Moreover, from time to time he is passively transported at the highest velocities in the enormous limits of space. 43

Motion sickness is the most important practical problem in the medical service of different kinds of transportation: railroad, marine, air-borne, cosmic, etc. The problem is not only that in moving man's organism, the state of discomfort is experienced. Motion sickness even in latent stages reduces the professional capacity for work of pilots, cosmonauts, and others.

The development of effective prophylactic measures is possible if a basic theory of the etiology and pathogenesis of the disease is present. The Soviet Theory was created by V. I. Voyachek and K. L. Khilov. The universality of the disease was noted first of all: motion sickness can develop when using practically any kind of transportation. Its basic cause is lengthy and periodic movements of a body associated with the effect of accelerations. The basic pathogenetic mechanism of motion sickness is the reflex mechanism. A leading role in the onset of motion sickness belongs to the otolithic part of the vestibular analyzer, so that the theory has received the name 'otolithic'. Stimulation of the receptors of the semi-circular canals of the labyrinth can also

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\*Numbers in the margin indicate pagination in the foreign text.

lead to the development of a similar symptomatology ("sickness of canals"). There also exists an additional mechanism of onset of motion sickness, namely, the conditioned reflex mechanism. Motion sickness develops according to the principle of the sum of physiological effects associated with stimulation of the analyzer receptors which carry out the analysis of space, namely: the vestibular, optic, motor, tactile, and interoceptor receptors. Sensitivity to motion sickness is a function of the initial state of the organism and, in turn, of the state of the central nervous system. External and internal factors, such as hypoxia, noise, smells, disease, and fatigue play a definite role in the development of motion sickness. Resistance to motion sickness increases as a result of training.

Professor G. L. Komendantov et al., in developing the status of the 'otolithic' theory of motion sickness, introduced important additions. They established that there are four phases in the development of motion sickness: in the first, or initial phase, there occurs irradiation of weak excitation in the cerebral cortex from the nerve structures which carry out the function of equilibrium. In this phase the sense of smell is sharpened in subjects, excitation and lability of the optic analyzer is heightened, and the tempo of mental work is speeded up.

In the second phase a stronger excitation process is concentrated in the structures that carry out the function of equilibrium and as a consequence of negative induction, inhibition simultaneously develops over the entire nervous system. A sensation of suppression, a turning pale of the integument, increased perspiration, and a lowering of the capacity for work appear.

The third phase of motion sickness is characterized by the fact that a strong excitation appears in the structures carrying out the function of equilibrium and periodically radiating along

the central nervous system. It involves an intense reaction of a series of centers, as a result of which vomiting develops, the cardiovascular and cardiorespiratory systems and other systems of the organism undergo significant changes, and the capacity for work significantly decreases.

Unlimited inhibition is characteristic for the fourth phase, which first appears in remote nerve structures and then in broader regions of the central nervous system. Hypnotic phases have been discovered in conditional reflex activity, and drowsiness, adynamia, stuporific state, and fainting have been observed.

Four clinical types of motion sickness are presently known: nerve, cardiovascular, gastro-intestinal, and the mixed type. The development of a sickness of one type or another is due to hidden functional or organic insufficiency of these systems and the destruction of homeokinesis. The most labile system that reacts to acceleration is the cardiovascular system.

Investigations have been conducted for clarifying the role of the separate analyzers that are sensitive to bodily movement in space and the genesis of motion sickness. The destruction of the function of one of these analyzers can lead to a distortion of the activity of the entire functional system. A weakening of the integrating activity of cerebral cortex in processing the flow of information from the spatial analyzer is apparently the basic pathogenic mechanism of the cosmic form of motion sickness.

A positive direction in studying the pathogenesis of motion sickness was developed by Prof. M. D. Yemel'yanov and his coworkers. They established that the vestibular vegetative reflexes are distinguished by a normally functional vestibular analyzer, that they

maintain equilibrium and various attitudes. The intensity and diversity of motion sickness symptoms are due to the functional state of the higher vegetative centers at each given moment, which in turn depend on extralabyrinthine impulses. Direct relations between the vestibular and vasomotor centers have been discovered.

Prophylaxis of motion sickness consists above all in the selection of healthy candidates for driving and piloting specialties, and in training. Techniques of double axis rotation with continuous and intermittent Coriolis acceleration are currently used for testing driving and air crews. The A. I. Yarotskiy method can be recommended for training. This is a complex of physical directions consisting basically of bowing, turning, and angular motion of the head.

Pharmaceutical methods are used for prophylactic purposes. Aeron [scopolamine camphorate 0.0001 g, hyoscyamine camphorate 0.0004 g] was taken out of production since it turned out to be ineffective and caused severe unpleasant side effects. The more perfected preparation Plavefin has begun to be introduced. Laboratory tests have shown a high effectiveness for a series of pharmaceutical compounds.

It is recommended that the medicine be taken 30-60 minutes before take-off for prophylaxis of motion sickness. It is necessary before flight to rest well and have a good sleep; and it is advisable to take food 2-3 hours before take-off: "a man who completes a flight on an empty stomach suffers motion sickness twice as fast. A cup of warm tea or coffee can safeguard against motion sickness in short-term flights (1-2 hours).

It has been established that intravenous administration of a 50 ml 4-5% solution of sodium hydrocarbonate not only inhibits

the development of motion sickness, but also effectively inhibits Menière's disease as well as even hypertensive syndrome. Daily administration for 21 days of 1-2 special suppositories containing 0.3-0.7 g dose of sodium bicarbonate assists in increasing statokinetic stability. When needed, a treatment is repeated for a week.

It is known that some people cannot endure even short-term (20-40 seconds) weightlessness. For the participants of future civilian jetliners, weightlessness in these flights is bound to last 15-20 minutes. It is quite obvious that passengers will not undergo pre-flight examination. These and many other questions await answers.

Motion sickness at the present time is a major problem of medical and social knowledge, bearing not only on transport, but also on production.